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Optimization of GRP Protocol in IEEE 802.11g MANET for variable neighbor expiry time

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Abstract: Mobile ad-hoc network (MANET) provides proficient wireless communication by adopting ad-hoc routing functionality in mobile nodes. The MANET node results in frequent network topology changes, making routing a challenging task. This work is an attempt towards an optimization of geographic routing protocol (GRP) in IEEE 802.11g MANET. The system has been designed and investigated for different network sizes and variable mobile nodes density. To optimize the performance of GRP route information based IEEE 802.11g MANET nodes; the various quality of service (QoS) parameters such as, end-to-end delay, packet delivery ratio, network load, average throughput, number of hops/route, and normalized routing load has been determined using the parameter neighbor expiry time (NET). The simulation results show that with neighbor expiry time of 8, network performance is better from default value for IEEE 802.11g MANET networks.

Keywords: MANET, GRP, NET, OPNET modeler 14.5

I. INTRODUCTION

Technological advancement & competition among mobile operators has contributed to wireless Networks growth to 1700 million in 2010 and is predicted this growth will continue to rise rapidly 2500 million by the end of 2017[1]. MANET represents a system of wireless mobile nodes that can freely and dynamically self-organize in to arbitrary and temporary network topologies, allowing people and devices to communicate without any pre-existing communication [2]. Each MANET node may be prepared with different type of radio devices that have unstable transmission and receiving capabilities and possibly operate on multiple asymmetric frequency band links, which might result in heterogeneity in the radio capabilities to transfer its information. This creates additional problems along with the problems of impulsive dynamic topology [3]. Protocols can be divided into three categories proactive, reactive and hybrid. Proactive protocols maintain route to all nodes, including nodes to which no packets are sent and are activated only when they are explicitly needed to forward packets. Hybrid method combines proactive and reactive methods to find efficient routes, without much control overheads [4]. GRP is an example of hybrid routing that utilizes the concept of geographic routing for the exchange the information. Position based routing or geographic routing is used to eliminate the limitations of topology based routing. It gives the better performance in dynamic topologies or networks [5]. The performance of the GRP protocol has been optimized using the parameter NET i.e. Neighbor Expiry Time. NET is the time which is set for a node to receive a hello message from its neighbor node. When the node does not receive the hello message from the neighbor node for the exceeding of the neighbor until expiry time, the node assumes that the packet a link has been lost [6].

Sharma S. et al. [7] surveyed on routing protocols and geographic routing protocols using GPS in MANET with their characteristics, functionalities, benefits and limitations. Authors observed MANET is a dynamically changing network topology, in which the energy consumption increases with the increase in mobility, so it is harder to achieve the better energy efficiency. Authors had purposed the protocol named as energy saving geographic routing protocol (ESGRP) using with GPS which provides lower energy cost for effective routing solution. Wadhwa D. et al. [8] compared different geographic routing protocol such as location aided routing (LAR), greedy perimeter stateless (GPSR) routing and energy aware geographic routing on the basis of performance metrics such as system life time, end to end delay and packet delivery ratio and energy utilization. Authors reported that the geographic routing gives high packet delivery ratio, better energy utilization and better network lifetime as compared to other protocols when the topology changes dynamically and when the mobility is high. Menon V. G. et al. [3] analyzed the performance of the different geographic routing protocols in high mobility zone. Authors compared the performance of different geographic routing protocols on the basis of performance metrics and listed the merits and demerits of these protocols. Authors discussed the different parameters involved for scheming and choosing a routing protocol.

This paper focuses on the optimization of GRP protocol in IEEE 802.11g MANET using different value of neighbor expiry time. The paper is divided into four different section. In section 1, the brief introduction of GRP, NET and MANET, section 2, describes the simulation setup for optimization of GRP protocol. In section 3, results of GRP for different node density have been discussed. Section 4, reports the conclusion of this research work.

II. SYSTEM DESCRIPTION

MANET network has been designed for different network sizes i.e. 50×50 m^2, 100×100 m^2, 150×150 m^2, 200×200 m^2, 250×250 m^2 with mobile nodes density i.e. 20, 40, 60, 80, 100 respectively for varying vector mobility 0.8 to 1.2 meters per second. Mobility model used is random waypoint model with mobility of 500m. The work is established using high file transfer protocol network traffic load applications for simulation interval of 5 minutes at high data rate under IEEE 802.11g physical layer standard.

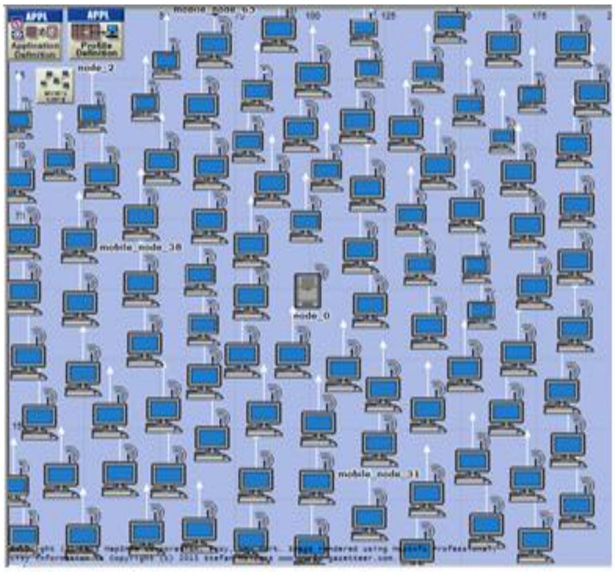

Fig.1. Model of MANET network using OPNET simulator 14.5.

TABLE I: Parameters of IEEE 802.11g MANET

Ad-hoc Routing Protocol	GRP
Wireless LAN MAC Address	Auto Assigned
Physical Characteristics	IEEE 802.11g
Data Rates(bps)	54 Mbps
Buffer Size	1024 kbps

The nodes are chosen in fixed size MANET with varying the network areas numbers because with increasing the node density congestion in the network increases and the exact performance cannot be calculated clearly. The performance of the MANET network is evaluated by implementing hybrid GRP routing protocol in different scenarios according to network size. The buffer size of data is set to 2024kbps for each mobile workstation at data rate of 54Mbps with 802.11g PHY layer anddistributed coordination function-medium access control (DCF-MAC) Protocol implementation with parameters given in Table I. The traffic flows randomly between different workstations placed at different distances in different scenarios.

III.RESULTS AND DISCUSSIONS

To optimize the performance of GRP route information based IEEE 802.11g MANET nodes, various QoS parameters such as, end-to-end delay, packet delivery ratio, network load, route discovery Time, number of hops/route, average throughput and normalized routing load has been determined during the active research. During the research work, the performance of the GRP protocol has been optimized using the parameter NET i.e. neighbor expiry time. NET is the time which is set for a node to receive a hello message from its neighbor node. When the node does not receive the hello message from the neighbor node till neighbor expiry time, the node assumes that the packet in a link has been lost. The different values of neighbor expiry time have taken for optimizing the performance of GRP. Figure 2 shows the end-to-end delay at different values of the neighbor expiry time with the increasing node densities. It can be seen from the graph that delay of the GRP is high at lesser value of the neighbor expiry time. With the increase in the node densities the delay increases. As the value of the neighbor expiry time increases the delay becomes low. The delay of the GRP is lesser at the constant value of NET i.e. 8 which is 0.517 ms at 20 nodes and 0.733 ms at 100 nodes.

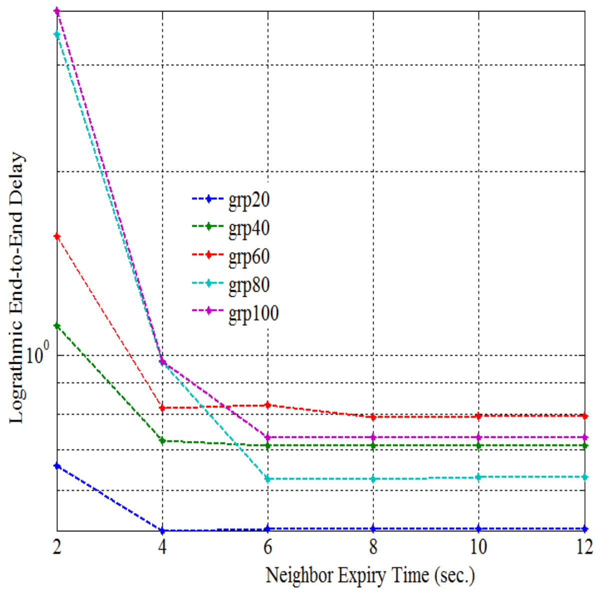

Fig.2. End-to-End delay in IEEE 802.11g MANET using hybrid routing scheme

Figure 3 shows the overall network load of the GRP protocol at different values of the neighbor expiry time. As shown in the graph the network load of the GRP is high at lesser value of neighbor expiry time i.e. 191.43kbps at 20 nodes and 4443.083kbps at 100 nodes for the NET value 2. But with the increase in the value of NET the network load becomes lesser as compared to previous values. From the graph it can be seen that at the NET value 8, the network load becomes lesser than other values of the NET i.e. 133.96kbps at 20nodes and 638.81kbps at 100 nodes but it increases with the increase in the value of NET.

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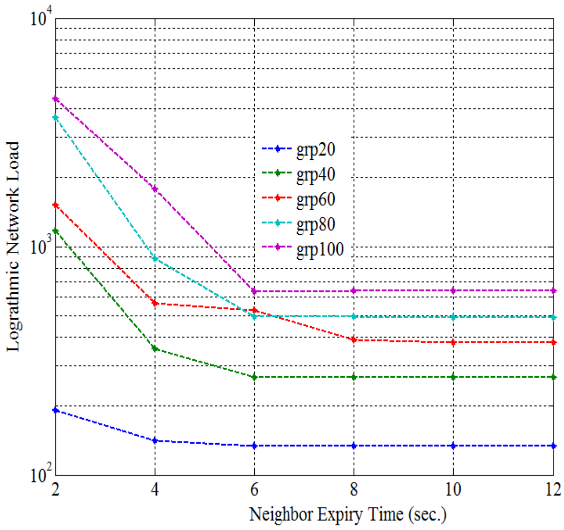

Fig.3. Network Load in IEEE 802.11g MANET using hybrid routing scheme

Figure 5 shows the packet delivery ratio which is ratio of traffic received to the traffic sent which is 0.765 at 20 nodes and 0.464 at 100 nodes for the NET value 2 and it is 0.980 at 20 nodes and 0.905 at 100 nodes for the NET value 8.With increase in NET the PDR becomes lesser than NET value 8 and it is also poor at lesser values of the NET which is nearly 0.7 at lesser number of network nodes and with increase in the network node it becomes more poor but at value of 8 the PDR becomes the nearly 0.9.

Figure 6 shows the normalized routing load of the GRP protocol which is poor at NET value 2, with increase in the network nodes it becomes poorer but at the value of NET at 8 it becomes better as compared to previous values of NET i.e. 19.095 at 20 nodes and 70.006 at 100 nodes. Figure 7 shows the no. of hops per route taken by each packet for reaching its destination whose value is nearly to 1 at NET value 8.

As shown in the figure 4 average throughput of the GRP which is maximum at NET value 8 of the which is 194.58kbps at 20 nodes and 1502.27kbps at 100 nodes. With the increase in network node density, the throughput of the GRP increases.

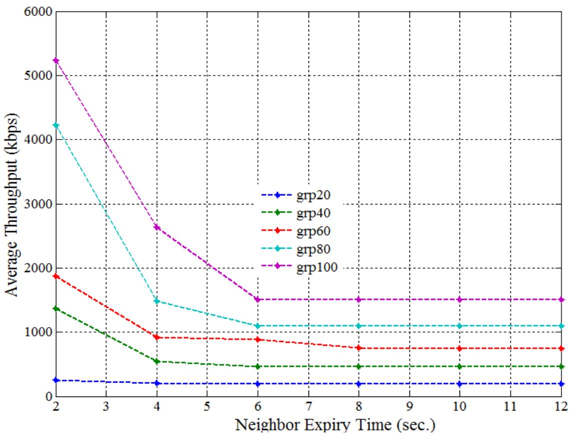

Fig.4. Average Throughput in IEEE 802.11g MANET using hybrid routing scheme

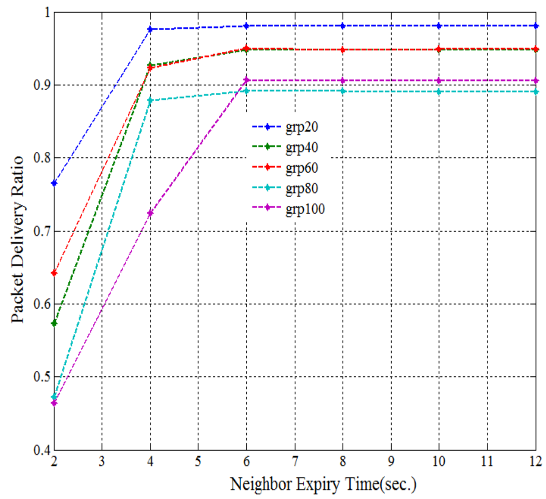

Fig.5. PDR in IEEE 802.11g MANET using hybrid routing scheme

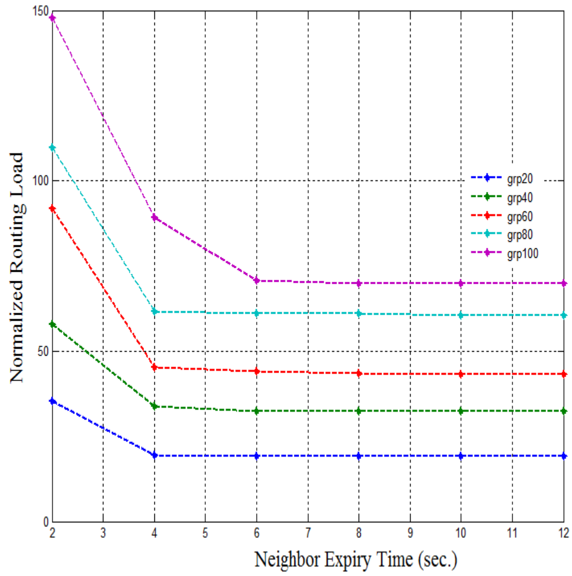

Fig.6. NRL in IEEE 802.11g MANET using hybrid routing scheme

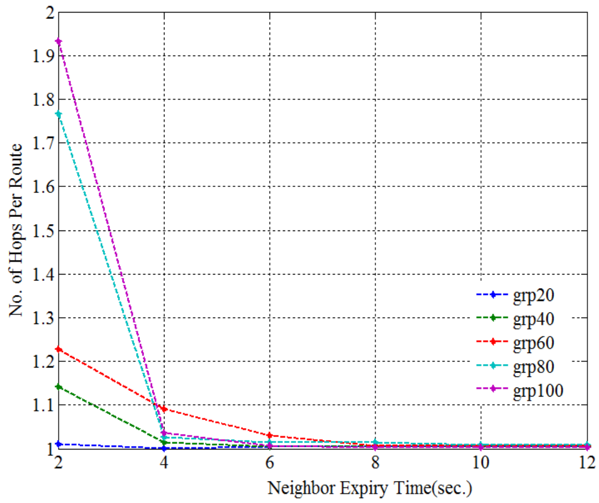

Fig.7. No. of Hops per Route in IEEE 802.11g MANET using hybrid routing scheme

Figure 7 shows the graph between number of hopes/route and NET. It has been observed that as the NET increases, number of hopes/route decreases. From the graphs, it has been concluded that at smaller values of NET and with the increase in the node density, the performance of the GRP protocol is poor but with the increase in the NET the performance becomes better than smaller value. The performance of the GRP is better at NET value 8 than other values of the NET.

IV. CONCLUSION

This work optimization of GRP protocol based route information for IEEE 802.11g MANET nodes. The various QoS parameters such as, end-to-end delay, packet delivery ratio, network load, average throughput, number of hops per route, normalized routing has been determined using the parameter NET. It has been observed that delay increases with increase in node densities but delay decreases with increases in neighbor expiry time. Further, the network load decreases with increase in the value of NET. It has been also concluded that, throughput of GRP is higher at higher network node density and the packet delivery ratio increases with increase in NET. It has been concluded that at smaller values of NET and with the increase in the node density, the performance of the GRP protocol is poor but with the increase in the NET the performance becomes better than smaller value. The performance of the GRP is better at NET value 8 than other values of the NET.

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